Syllabus

Physical Cosmology - Part A
Part III Mathematical Tripos
Jochen Weller & Max Pettini
Institute of Astronomy

Webpage: `http://www.ast.cam.ac.uk/~jw249/Teaching/physcos.html`

Topics Part A (J.Weller)

I. Cosmography

- The Cosmological Principle
- Weyl's Postulate
- The Robertson-Walker Metric
- Friedmann Equations
- Cosmological Models
- Redshift
- Proper and Angular Diameter Distance
- Luminosity Distance and Deceleration Parameter
- Volumes
- Cosmological Magnitudes
- Type Ia Supernovae as Standardizable Candles – Phillips Relation
- Parameter Estimation

II. Dark Energy

- Generalized Equation of State
- Scalar Fields and Fine Tuning
- The Exponential Potential
- Tracker Solution

III. Large Scale Structure

- Linear Perturbation Theory
- Jeans' Mass
- Press-Schechter Formalism
- Zel'dovich Approximation

IV. Clusters of Galaxies

- Spherical Collapse and Virialization
- X-ray Signatures
- Sunyaev-Zel'dovich Effect
- Lensing
- Non-linear Clustering and Halo Model
- Navarro-Frenk-White Density Profile Function

Topics Part B (M. Pettini)

V. The Intergalactic Medium at High Redshift

- Introduction. QSO Absorption Lines. The Lyα Forest.
- Theory of Absorption Line Formation.
- Physical Properties of the Lyα Clouds.
- The Distribution of Column Densities and its Use as a Probe of the Baryon Density.

- The Ionising Background

VI. Big-Bang Nucleosynthesis

- Theoretical Framework.
- Confronting the Predictions with Measurements of the Abundances of the Light Elements.

Problem Classes

Fridays at 2pm of the CMS by Dr Matteo Viel (IoA) on January 23rd , February 6th, February 20th and the last supervision on Monday, March 8th at 2pm (each approx. 1.5 h). All supervisions are in MR 4 of the CMS.

Bibliography

Topic I - Cosmography

- Ray d'Inverno, *Introducing Einstein's Relativity*, Oxford University Press.
- Sean M. Carroll, *Spacetime and Geometry*, Addison Wesley.
- Steven Weinberg, *Gravitation and Cosmology*, Wiley & Sons.
- Malcolm S. Longair, *Galaxy Formation*, Springer.
- Marc L. Kutner, *Astronomy: A Physical Perspective*, Cambridge University Press.

Topic II - Dark Energy

- J. A. Peacock, Cosmological Physics, Cambridge University Press.

and mainly research articles

Topic III - Large Scale Structure

- E. W. Kolb and M. S. Turner, *The Early Universe*, Addison Wesley.
- J. A. Peacock, Cosmological Physics, Cambridge University Press.

- A. R. Liddle and D. H. Lyth, *Cosmological Inflation and Large-Scale Structure*, Cambridge University Press.

Topic IV
research articles and literature list given at a later stage.

Topic V

- Rauch, M. 1999, Annual Review of Astronomy and Astrphysics, 36, 267.

Topic VI

- Pagel, B.E.J. 1997, Nucleosynthesis and the Chemical Evolution of Galaxies, Cambridge University Press (Chapter 4).

Further to the bibliography here, various research articles will be mentioned during the lecture.